Programmed Database System at the Chang Gung Craniofacial Center: Part I

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Background: A database is a system for the management of information. Databases of different forms are widely used in everyday life from telephone books to online library catalogs. The Craniofacial Center at Chang Gung Memorial Hospital has seen over 20,000 patients during the past 20 years. All of the patient records need to digitally input into a computer database.

Methods: A database was custom designed using Paradox 8. The ACDSee Photo browser and DOS linked them to the original program. The Paradox 8 was programmed to a standard mode for the diagnosis and treatment data input to prevent typographical errors.

Results: We collected the records of 25,200 patients from 1987 to 2002, of which 24,331 underwent operations. The data for 14,828 patients were registered as complete and/or incomplete cleft and the proportions of unilateral to bilateral and female to male are presented in Table 1.

Conclusion: This new database system was designed to ensure the accuracy of data input using a standard model that is capable of correct data programming using the custom designed coding system for the Craniofacial Center. The system also provides easy and reliable data retrieval when using the powerful search tools.

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Key words: **database, craniofacial center.**

A database is a management system for information. Databases of different forms are widely used in everyday life from telephone books to online library catalogs.[1,2] They are also useful data processing tools used in various medical fields as patient records,[3-5] advisory systems,[6] practice settings,[4,7] clinic research,[8-10] financial control,[11] image management,[12-15] burn records[16-18] and antibiotic control.[19]

Effective management of cleft lip and palate patients requires multidisciplinary and longitudinal care involving the surgical, dental, otolaryngological, speech, and psychosocial aspects of patient care. During the past 20 years, 25,200 patients have been registered at the Chang Gung Craniofacial Center generating a huge amount of data that need to be classified and computerized to facilitate administration, registration, and study. Before 1993, the

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Craniofacial Center used the DBASE (III) program under the DOS system to record data. Due to the high diversity of information gathered from the patients, this was changed to a different software that was more flexible and could be written or programmed to suit the needs of the Craniofacial Center.

To perform this task, a database software called Paradox was used to organize textual data. After, 1998 another software called ACDSee was added to manage photographic documents. These databases were customized to allow detailed specification of all of the records in the database according to the needs of the Craniofacial Center, as well as validation of all entered information. Thus, data integrity was maintained through properties like referential integrity (i.e. making sure that information belonging to one record was linked together) and validity checks (i.e. making sure that entered data are correct). This allowed easy and accurate analysis of the data through the construction of tables, forms, and reports. The system used was clear and user-friendly. In addition, it had facilitated the work of the members of the Craniofacial team. The purpose of the software design was to collect exact and complete patient data including the personal data, diagnosis, operation, preoperative and postoperative images, and to provide powerful data retrieval tools for retrospective studies, clinical follow-up and teaching.

METHODS

During the past 20 years (1983 to 2002), the records of 22,500 in- and out-patients have been included in this database. The data collected from the patients of the Chang Gung Craniofacial Center included basic personal data, such as name, chart number, date of birth, address, as well as diagnosis and treatment oriented data, such as surgical, dental, otolaryngological, speech, and psychosocial findings.

A database was custom designed using Paradoxis 8, which is a full featured relational database management system that can be used either as a stand alone system on a single computer or in a multi-user system on a network using the PC windows 98/2000/NT system. It provides an Object Paradox Application Language (ObjectPAL)[19,20] scripting language for the user to identify other foreign systems such as the ACDSee and DOS and link them to the original program. (To be discussed in Part II of this paper.)

We would like to emphasize that the data is not only for recording and for storage, but more importantly it is for retrospective data retrieval and use. To fulfill this purpose we divided the database into several tables related to each other, through the Diagnosis and Operation fields. All of the data input for these two fields were defined using a combo list as a standard model to prevent typographical errors.

Table design and relationship

The three main groups in the craniofacial team that used this program were plastic surgery, orthodontics, and speech pathology. In this article, the discussion is focused on the tables used by the plastic surgery group. These tables contained the patients' personal data (Patient), Diagnosis I (DX I), Diagnosis II (DX II), Diagnosis III (DX III), Diagnosis IV (DX IV), operation for cleft lip and palate anomaly (OP I), other operations (OP II), and photographs (Photo). The table for OP I was related to the DX I and DX II in the cleft lip and palate patient group only. The DX III was related to other diagnoses, and the DX IV was used to identify cases with hemifacial microsomia because of a special research interest in this patient group. The OP II table was related to the patients with non-cleft lips and palates found in tables DX III and DX IV. All of the tables are related to the original personal data (Fig. 1).

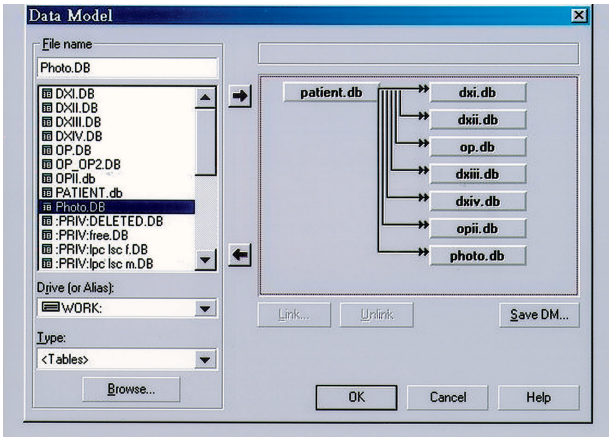

Fig. 1 The first eight tables in the database show the relationship of linking the tables together with the keys.

Standardized data input

To guarantee exact data input and retrieval, the data encoding of the diagnosis (DX) and operation (OP) fields were designed as the standard model of the combo, combo list and direct definition field input by clicking an option box (Fig. 2).

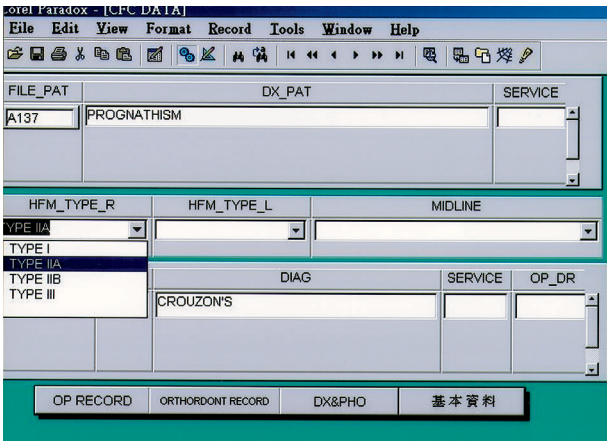

Fig. 2 The combo list design for a standard model data input.

Data retrieval for retrospective studies and follow up

Based on the standardized data input it was possible to retrieve the exact data for purposes of studies and patient follow up. For the simple retrieval of the patient records, the database was programmed to search for the chart number and with this information, locate the personal data, diagnosis, operation, and imaging data. For complex data retrieval as in retrospective studies, the Paradox software is provided with a search tool that can recall the data combined in several tables depending on the search conditions (Figs. 3, 4).

After we programmed the Database, the system proceeded systematically as in Figure 5, and presented on screen as in Figure 6.

Coding system

The diagnosis and operation coding system used was the one designed by our cleft team in 1983. The cleft lip and palate diagnosis also used the modified striped Y graphic classification from Kernahan together with a definition of the deformities. They included the Right primary complete deformity (RPC), Right primary incomplete deformity (RPI),

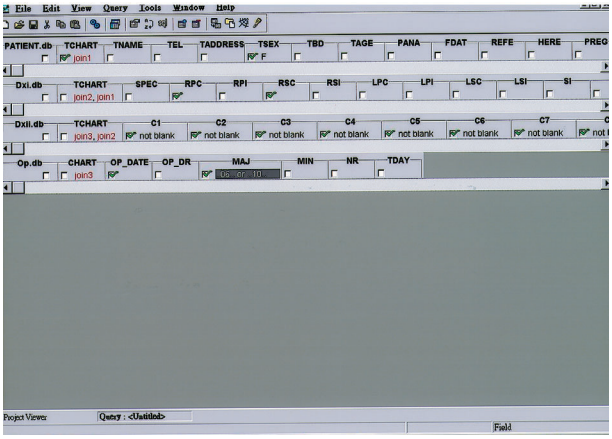

Fig. 3 The Paradox provided a search tool for retrieving data from multiple tables with several combinations and conditions. In this example, four tables are linked to look for the number of female patients with right primary and secondary complete cleft lips and palates. The conditions F in TSEX field, RPC in RPC filed, RSC in RSC field, and C1 to C9 are all checked including the operation data in OP_DATE field with the procedure codes 06 or 10 for cheiloplasty or palatoplasty.

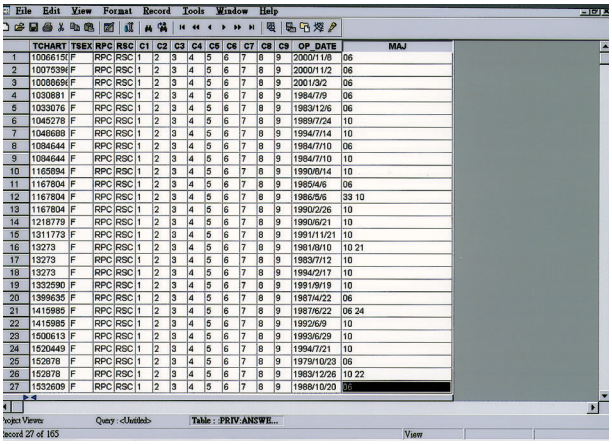

Fig. 4 The results retrieved for the search in Figure 5 shows the total number of female patients with right complete cleft lips and palates who underwent cheiloplasty or palatoplasty. The total number was 165 as shown in the lower left hand corner of the window.

Right secondary complete deformity (RSC), Right secondary incomplete deformity (RSI), Left primary complete deformity (LPC), Left primary incomplete deformity (LPI), Left secondary complete deformity (LSC), Left secondary incomplete deformity (LSI),

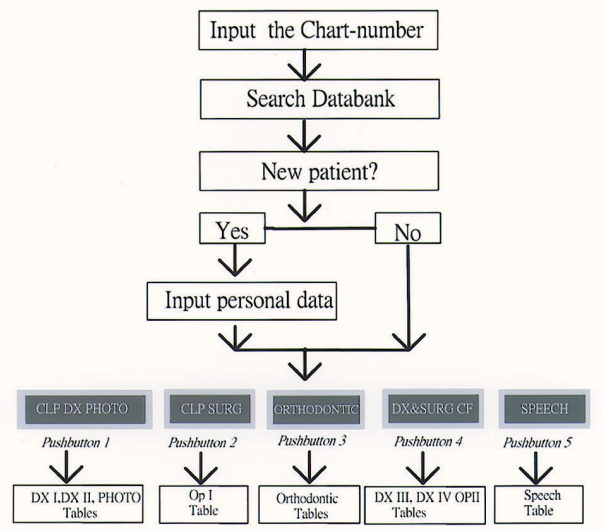

Fig. 5 Diagram for the Database Flow Chart of running the archive file tables in form.

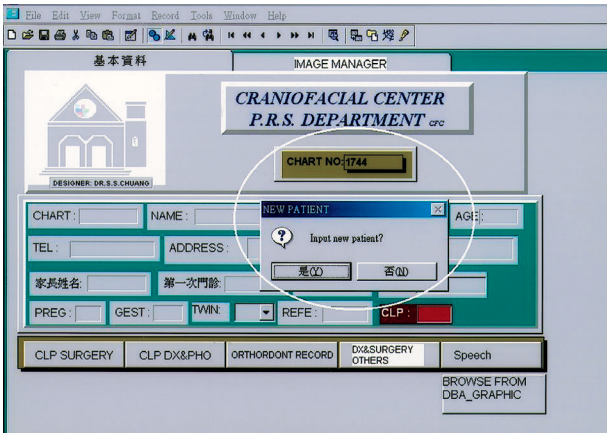

Fig. 6 The first screen for the Database starts to Input a new data. After searching the database, the dialog box shows the results and makes a conformation.

Bilateral secondary incomplete deformity (SI), and Bilateral secondary complete deformity (SC).

RESULTS

We recorded 25,200 patients from 1987 to 2002, which involved 24,331 operations. Data from 14828 patients were registered as complete and/or incomplete cleft palate in the DX I table. In the DXII table based on the Y-shape diagnosis, 13,413 patients were recorded. Only 9,142 patients had complete diagnostic data while the other patients had prior operations in different hospitals hence the detailed diagnostic classification could not be obtained. In the registry there were 2,109 unilateral cleft lips, 949 were female and 1,160 were male. Seventy-eight patients had isolated cleft palates. In addition, 2,877 patients had cleft lip and palate, and 1,154 of these were female, and 1,673 were male. Whether the defect was cleft lip or cleft lip and palate, there was a higher incidence on the left side. The patients with bilateral clefts included 236 of the lip, 2,726 of the palate, and 1,166 of the cleft lip and palate. The female to male ratios are listed in Table 1. There are 52,310 digital photo images in the entire database. (This will be discussed in Part II.)

Table 1. Number of Cases Registered in the Database, Showing the Gender and Areas Involved (Chang Gung Craniofacial Center, Linkou, 2003).

Gender		Female	Male
Cleft lip	right	329	450
	left	620	710
	Total	949	1160
Cleft palate	right	11	23
	left	22	22
	Total	33	45
Cleft lip and palate	right	367	576
	left	787	1097
	Total	1154	1673
Bilateral Cleft lip		117	119
Bilateral Cleft palate		1653	1073
Bilateral Cleft lip and palate		452	714
Total		4358	4784

DISCUSSION

A database is an organized collection of information based on specific data such as date of operation, diagnosis and operation procedures. Data normalization is the arrangement of voluminous data into separate tables with each table containing the fewest number of fields necessary to establish unique categories. Rather than using one large, complex table that contains numerous columns, normalized tables distribute the information over many tables using fewer fields. This is why our Craniofacial Center changed from DBASE III to Paradox and

divided the system into several tables.

In a relational database such as the Paradox, the collection of tables contain categories of data designated as key which appear repeatedly to allow easy identification of the same records in the different tables. The data in these key fields need to be encoded only once, and they automatically appear in all of the tables.[19] In other database software, this is called the index.

The tables were located in designated combo boxes and appeared when the appropriate box was clicked. Data could then be entered either by double-clicking the appropriate box or by entering the code. This prevented data entry errors such as misspelling or typographical errors. It also facilitated the work of the encoder. To double check the code entries, the actual information would be shown in the next field in complete text as soon as the code was input so that the operator could see whether the code was typed correctly. The diagnosis and operation data were designed in the same standard model double-click fashion as the cleft DX I and DX II tables.

Once the database system was designed on the Paradox, the software was installed in the other computers at the Craniofacial Center and the program was copied into it. Four workstations were assigned as data encoding areas (two for textual data and two for photographic data) while the rest were assigned as read-only stations. Data transfers, back ups and updates within the computer network system were performed using the command autoexec.bat which was written under the DOS language of the computer. This ensured that the data would be automatically copied into the hard drive of one computer and to the hard drives of the other computers. Thus, the data of the Craniofacial Center was stored several times in different locations to safeguard against loss. The back up and update processes were designed to take place whenever the computer was shut down and switched on, but not in real time to prevent flooding the network lines throughout the day.

In this system, we used our self-developed coding system and not the international coding system (ICD-9) for several reasons. First, the continuity with the old database that has been used since 1987 was maintained. The purpose of this database was for specific departmental records, study and patient follow-up. It is not related to the administration department in charge of insurance collection and patient charges. Second, the diagnosis code containing the modified striped Y graphic classification from Kernahan was clearly linked to the Operation code and was easy to read. It was highlighted from the data retrieved. Third, both the diagnosis and operation fields used the coding system to coordinate with the descriptive text, and were convenient for the staff to read out. Finally, when necessary, the present coding system could be easily converted to the ICD-9 system.

We recorded 14,828 patients in the DXI table and 13,413 in the DXII table. Two tables with different classifications and different coding methods were actually used for the same patients. Unfortunately only 9142 of the patients had complete data for our study. The discrepancy from the total number of patients was due to a variety of reasons. Some operations were performed at other hospitals hence the detailed cleft diagnosis was not known. Another reason was that when the data was converted from DBASE III in DOS format to the Paradox in Windows format, some of the non-standardized data were invalidated. Some reasons were manual errors committed under the old database format. Errors are not possible now in the new format because of the data input design that uses boxes to encode the new data.

The limitation of the capacity in the Database is unknown, however, 1,737,457 records for the biochemical ad hematological examination have been input from the Burn unit. So far, the database has not reached its maximum limit. A database in commercial usage is simply used for storage, sales, financial, and customers' basic data. However, the medical data related to the diagnosis, treatment, following up, and digital images are all related each other. Thus, there was no simple database to fill the needs of clinical usage. This new database system was designed to ensure the accuracy of data input using a standard model that is capable of correct data programming using the custom-designed coding system developed for our Craniofacial Center. In addition, the system provides easy and reliable data retrieval whenever necessary using the powerful search tools.

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長庚顱顏中心實用資料庫軟體：第一篇

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背 景： 長庚醫院顱顏中心患者總數超過兩萬名。每年定期回診，資料不斷更新，各項門診檢查、牙科追蹤、手術治療等資料整理，需龐大人力處理。爲求有效迅速整理及查詢資料庫內容，必須使用關聯性資料庫來進行檔案分析。

方 法： 使用特殊設計的Paradox 8資料庫軟體，ACDSee照相圖檔資料庫及DOS系統。Paradox同時加以標準化處理，以便不斷增加新的資料而不會重複。

結 果： 自1987年至2002年共計25,200病歷，接受24,331次手術存儲在本資料庫內。共有1,4828名唇顎裂患者之唇顎裂形態及分布比例可以參考。

結 論： 此一軟體提供了可靠及穩定的資料整理方法，足以供應立即的資料檔案以利教學研究之用。

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關鍵字： 資料庫，顱顏中心。

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